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A Survey Report on Cloud Computing Testing Environment

[1] Tarun Kumawat, [2] Naresh Kumar Marwal, [3] Shritosh Kumar, [4] Parmeshwar Lal Bhanwariya

[1,2,3,4] CSE, JECRC UDML College of Engg. Kukas, Jaipur, Rajasthan, India

ABSTRACT - Cloud computing not only changes the way of obtaining computing resources (such as computers, infrastructures, data storage, and application services), but also changes the way of managing and delivering computing services, technologies, and solutions. Cloud computing leads an opportunity in offering testing as a service (TaaS) for SaaS and clouds. Meanwhile, it causes new issues, challenges and needs in software testing, particular in testing clouds and cloud-based applications. This paper provides a comprehensive tutorial on cloud testing and cloud-based application testing. It answers the common questions raised by engineers and managers, and it provides clear concepts, discusses the special objectives, features, requirements, and needs in cloud testing. It offers a clear comparative view between web-based software testing and cloud-based application testing. In addition, it examines the major issues, challenges, and needs in testing cloud-based software applications. Furthermore, it also summarizes and compares different commercial products and solutions supporting cloud testing as services.

Keywords **- Cloud testing, Cloud-based software testing, Testing cloud services, Performance testing and evaluation, and scalability testing, TaaS.**

1. Introduction

In very simple definition provided by Wikipedia, Cloud computing is Internet-based computing, whereby shared resources, software, and information are provided to computers and other devices on demand, like the electricity grid. The cloud is often characterized by self-service interfaces that let customers acquire resources when needed and as long as they are needed. Cloud is also the concept behind an approach to building IT services that takes advantage of the growing power of servers and virtualization technologies. A cloud is grouped into private or public cloud based on the location of the data center where the services are being virtualized. In general, a public cloud is an environment that exists outside the purview of company firewall, could be a service/technology offered by a third party vendor while private cloud acts behind the firewall for the exclusive benefit of an organization and its customers. In a hybrid cloud environment, external services are leveraged to extend or supplement an internal cloud. Cloud computing not only brings new business opportunities, but also causes some major impacts on software testing and maintenance. A major impact is known as Testing as a Service (TaaS) in Clouds. TaaS cloud infrastructures is considered as a new business and service model, in which a provider undertakes software testing activities of a given application system in a cloud infrastructure for customers as a service based on their demands.

2. Understanding Cloud Testing

Cloud computing provides a cost-effective and flexible means through which scalable computing power and diverse services (computer hardware and software resources, networks and computing infrastructures), diverse application services, business processes to personal intelligence and collaboration are delivered as services to large-scale global users whenever and wherever they need.

Cloud computing is the next stage of the Internet evolution. A typical cloud must have several distinct properties: elasticity and scalability, multi-tenancy, self-managed function capabilities, service billing and metering functions, connectivity interfaces and technologies. In addition, a cloud supports large scale user accesses at distributed locations over the Internet, offers on-demand application services at anytime, and provides both virtual and/or physical appliances for customers. There are three types of clouds: a) private clouds, which are internal clouds based on a private network behind a firewall; b) public clouds, which are the clouds with public accessible services over the Internet; and c) hybrid louds, which are made of different types of clouds, including public and private clouds.

2.1 What is Cloud Testing

Cloud testing is a form of software testing in which Web applications that leverage Cloud computing environments ("cloud") seek to simulate real-world user traffic as a means of load testing and stress testing web sites. The ability and costs to simulate Web traffic for software testing purposes has been an inhibitor to overall Web reliability." Based on our recent literature survey, there is a few of published papers addressing cloud-testing concepts, issues, and challenges. There are some other views about cloud software testing from practitioners in the real world. They are listed below.

"Cloud testing basically aligns with the concept of cloud and SaaS. It provides the ability to test by leveraging the cloud, thereby bringing the same benefits that the cloud brings to customers...." (by Vinita Ananth, Director - APJ Region, HP Software-as-a-Service). "Testing in the cloud leverages cloud computing environments and seeks to simulate real-world user traffic as a means of load or stress testing Web sites". (By Nivedan Prakash). "Cloud testing is the answer to the less-than-realistic performance test that originates within the infrastructure of one of our clients. When we use cloud testing, we take advantage of hardware and bandwidth that more closely mimics our observed, real world conditions. Essentially, we execute the test in cloud-based infrastructure and bandwidth." (R V Ramanan, President – Global Delivery and Chief Software Architect, Hexaware Technologies).

In short, cloud-based software testing refers to testing and measurement activities on a cloud-based environment and infrastructure by leveraging cloud technologies and solutions. It has four major objectives.

- To assure the quality of cloud-based applications deployed in a cloud, including their functional services, business processes, and system performance as well as scalability based on a set of application-based system requirements in a cloud.
- To validate software as a service (SaaS) in a cloud environment, including software performance, scalability, security and measurement based on certain economic scales and pre-defined SLAs.
- To check the provided automatic cloud-based functional services, for example auto-provisioned functions.
- To test cloud compatibility and inter-operation capability between SaaS and applications in a cloud infrastructure, for example, checking the APIs of SaaS and their cloud connectivity to other.

2.2 Why is Cloud Testing Important

Comparing with current software testing, cloud-based testing has several unique advantages listed below.

- Reduce costs by leveraging with computing resources in clouds – This refers to effectively using virtualized resources and shared cloud infrastructure to eliminate required computer resources and licensed software costs in a test laboratory.
- Take the advantage of on-demand test services (by a third-party) to conduct large-scale and effective real-time online validation for internet-based software in clouds.
- Easily leverage scalable cloud system infrastructure to test and evaluate system (SaaS/Cloud/Application) performance and scalability.

3. Types of Cloud Testing

(1) Stress Test: Stress Test is used to determine ability of application to maintain a certain level of effectiveness beyond breaking point. It is essential for any application to work even under excessive stress and maintain stability. Stress testing assures this by creating peak loads using simulators. But the cost of creating such scenarios is enormous. Instead of investing capital in building on-premise testing environments, cloud testing offers an affordable and scalable alternative.

(2) Load Test: Load testing of an application involves creation of heavy user traffic, and measuring its response. There is also a need to tune the performance of any application to meet certain standards.

(3) Performance Test: Finding out thresholds, bottlenecks & limitations is a part of performance testing. For this, testing performance under a particular workload is necessary. By using cloud testing, it is easy to create such environment and vary the nature of traffic on-demand. This effectively reduces cost and time by simulating thousands of geographically targeted users.

(4) Functional Testing: Functional testing of both internet and non-internet applications can be performed using cloud testing. The process of verification against specifications or system requirements is carried out in the cloud instead of on-site software testing.

(5) Compatibility Testing: Using cloud environment, instances of different Operating Systems can be created on demand, making compatibility testing effortless.

(6) Browser Performance Testing: To verify application's support for various browser types and performance in each type can be accomplished with ease. Various tools enable automated website testing from the cloud.

(7) Latency Testing: Cloud testing is utilized to measure the latency between the action and the corresponding response for any application after deploying it on cloud.

4. Cloud Test Environment

There are three types of cloud test environments:

- A cloud-based enterprise test environment, in which application vendors deploy web-based applications in a cloud to validate their quality in a cloud infrastructure.
- A private/public cloud test environment, in which vendors deploy SaaS applications SaaS in a private (or public) cloud to validate their quality.
- A hybrid cloud test environment, in which vendors deploy cloud-based applications on a hybrid cloud infrastructure to check their quality.

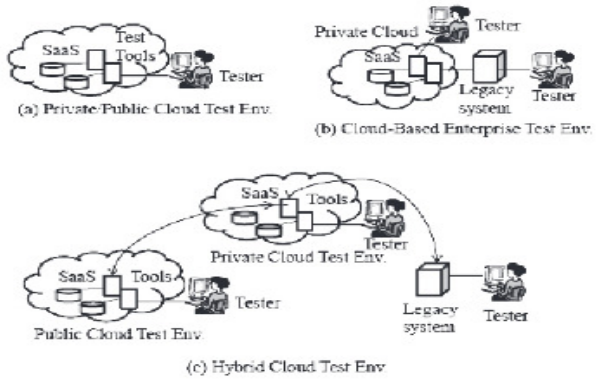

Fig. 1: Cloud Test Environment

5. Testing Challenges

Table 1: Challenges in Cloud Computing Testing Environment

Challenge Category	Challenges
Service Challenge	1. Service Availability 2. Service Assurance 3. Service Efficiency
Security Challenge	1. Confidential Data Security 2. Depending on customer data 3. Meeting Security Requirements
Layered Testing Challenge	1. Three layers testing Protocol 2. Communication between Layers
Lack of Universal Standard and Infrastructure	1. Limited Technology configuration 2. Limited Servers and Storage Infrastructure 3. Networks interconnectivity 4. Virtualization level
Guidance, Knowledge and Staff Expertise	1. Obtaining Guidance 2. Expertise Teaching Staff 3. Acquiring Direct Knowledge
Procuring Cloud Service on-Demand Basis	1. Define Specific Quantity and Costs 2. Dependency on Remote Installed Applications 3. Increasing Expenditure on Encrypted Data
Other's Challenges	1. Planning of Test Environment 2. Accrediting Vendors which meets Standards 3. Ensuring Data Portability and Interoperability 4. Proper Utilization of Cloud Resources

5.1 Cloud Service Challenges

The fundamental challenge in cloud computing testing environment is the cloud service challenges. The first challenge in this category is service availability without experiencing undue delays because user organization is looking to adopt cloud services rather than maintain local installations. Cloud service must look and feel as local services rather than remote services. The second challenge is the cloud service assurance. The cloud services provider must assure timely delivery of cloud service and controls data communication connection between cloud service and corporate users. The final challenge is service efficiency. It encompasses efficiency in all aspects from cost savings, space and power efficiency to efficient and scalable cloud service delivery using virtualization, high end servers and high speed interfaces [IXIA,2011;Ravichandran,2012].

5.2 Security Challenges

Since information travels through the Internet, testers have to perform security testing to make sure there is no data

leakage when data is sent over the Internet. Security in the public cloud is still a major issue. The first challenge in this category is the security of the confidential data. There may come up the situation about the leakage of private information, internet suspending, and suddenly disruption of service due to a maintenance window, slow internet speed, virus attack. The second challenge is some test methods are depends upon the customer data. In order for effective testing to take place, some testing tasks depend highly on the actual customer or production data. In some cases, the customers are prohibited from supplying confidential or production data to third parties. So the test data should be doubly scrutinized for testing in cloud. The third challenge is meeting security requirements. Cloud vendors may not be familiar with security requirements that are unique to government agencies such as continuous monitoring and maintaining an inventory of systems [Ravichandran,2012; Swapnil H. Chandane & Prof. Mahip M. Bartere, 2013].3.3.

5.3 Layered Testing Challenges

The third major challenge category is the testing at multiple layers of the cloud environment. The first challenge in this is the layers testing Protocol. In this, the testing network connection, server performance, database and software application adds multiple layers to cloud testing. Testers have to test beyond what they can physically control in their environment [Priyanka et al., 2012; Swapnil H. Chandane & Prof. Mahip M. Bartere,2013].Second challenge in this is the maintaining communication between layers. In this, Testers have to test the communication between the layers, test connection between the elements and also plan for the risks such as connection breaks midway, server down and software crashes [Laurin H. Mills,2009; Priyanka et al., 2012].

5.4 Lack of Universal Standards and Limited

Infrastructure The fourth challenge category is the lack of standards and limited infrastructure in public cloud environment. The first challenge in this is the lack of universal standards. Presently, there are no proper universal standard solutions to integrate public cloud resources with user company's internal data center resources. Public cloud providers have their own architecture, operating models, pricing mechanisms and offer very little interoperability. This leads to a big challenge for companies when they need to switch vendors. The second challenge in this is the limited infrastructure. Some cloud providers offer only limited types of configurations, technology, servers, storage, networking and bandwidth which making it difficult to create real-time test environments [Laurin H. Mills, 2009;Pat Hyek,2011].

5.5 Obtaining Guidance, Knowledge and Staff Expertise

The fifth challenge category is the obtaining guidance, knowledge and staff expertise. The first challenge in this is the obtaining guidance for testing cloud service. Existing federal guidance for using cloud services is insufficient or incomplete. Agencies cited a number of areas where additional guidance is needed such as purchasing IT commodity and assessing information security management with security levels. The second challenge is the taking expertise teaching staff. Service provider may not have the necessary tools or resources such as expertise staff to implement cloud solutions. Teaching their staff an entirely new set of processes and tools such as monitoring performance in a cloud environment has been a challenge. A third challenge is the acquiring direct knowledge. Delivering cloud services without direct knowledge of the technologies and tools has been a challenge [Pat Hyek,2011; Swapnil H. Chandane & Prof. Mahip M. Bartere,2013].

5.6 Other's Challenges

The seventh testing challenge category contains some other's challenges related to testing a cloud computing environment. The first challenge in this is the planning of test environment and overcome cultural barrier. Testing teams should rigorously plan their test environments from utilization periods through disassembly with the awareness of the associated expenses such as cost of encrypting data, before putting testing in a cloud environment, since these requirements will consume additional CPU and memory. Organization culture may also act as an obstacle to implementing cloud computing solutions. The second challenge is the accrediting vendors which meets standards. Organization may not have a mechanism for certifying that vendors meet standards for security because the risk and authorization management program had not yet reached initial operational capabilities. Third challenge is the ensuring data portability and interoperability. To preserve their ability to change vendors in the future, agencies may attempt to avoid platforms or technologies that lock customers into a particular product. Forth challenge is the proper utilization of cloud resources. It is important to monitor utilization of cloud resources to avoid over-usage and over-payment.

6. Conclusion and Future Work

Cloud testing is becoming a hot research topic in cloud computing and software engineering community. As the advance of cloud technology and testing as services, more research work must be done to address the open issues and challenges in cloud testing and TaaS. More innovative

testing techniques and solutions, and QoS standards are needed to support on-demand testing services in a scalable cloud infrastructure. This paper provides a comprehensive review and tutorial on cloud testing by discussing the related concepts, issues, and challenges. The growth of cloud computing created a demand for benchmarks that can measure the performance characteristics of cloud applications. Testing teams should equipment themselves with viable strategies to mitigate the risks and issues associated with cloud computing by covering additional capabilities available in the cloud computing environment. Only a few advantages and a few testing challenges of the cloud computing solutions have been identified in this paper. In future, as it is getting more matured architecture for cloud computing and more and more testing on the cloud applications there is every possibility of more testing challenges which can be explored by researchers.

References

[1] J. Hurwitz, M. Kaufman, and R. Bloor, "Cloud Computing for Dummies," Wiley Publishing, Inc. 2010.

[2] T. Vengattaraman, P. Dhavachelvan, R. Baskaran, "Model of Cloud Based Application Environment for Software Testing," (IJCSIS), International Journal of Computer Science and Information Security, Vol. 7, No. 3, 2010.

[3] http://seij.dce.edu/Paper%201.pdf.

[4] http://www.thesij.com/papers/CSEA/2013/July-August/CSEA-0103550201.pdf.

[5] Spirent Communications (2010), "Cloud Computing Testing", Spirent Communications, California.

[6] Pat Hyek (2011)," Cloud Computing Issues and Impacts", Global Technology Industry Discussion Series.

[7] IXIA (2011), "Testing the Cloud: Definitions, Requirements and Solutions", August 2011, CA, URL: http://www.ixiacom.com/

[8] Neha Mehrotra (2011), "Cloud Testing Vs Testing a Cloud", Infosys Viewpoint.

[9] Prince Jain, Dr. Gurdev Singh & Isha Gulati (2011), "Process Model for Cloud Service Engineering", International Journal of Computer Applications, Vol. 36, No. 8.

[10] Vinaya Kumar Mylavarapu (2011), "Taking Testing to the Cloud", Cognizant Reports.

[11] Sergiy Vilkomir (2012), "Cloud Testing- A State of the Art Review", Information and Security- A International Journal , Vol. 28, No.2.

[12] Prince Jain (2012), "Security Issues and their Solution in Cloud Computing", International Journal of Computing & Business Research, Proceedings of 'I-Society 2012' at GKU , Talwandi Sabo Bathinda Punjab), India.

[13] http://arxiv.org/ftp/arxiv/papers/1402/1402.1925.pdf